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Definition and Existence of Multichannel Scattering States

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Abstract. The field theoretical formulation of quantum mechanics is used to consider the nonrelativistic multichannel scattering theory. With the help of appropriately constructed time dependent creation operators, Hilbert vectors are formed whose limits in time can be defined as multichannel scattering states in the usual sense. The existence of these states is proved under certain assumptions for the potential, by showing the convergence of the above mentioned operators. The commutation relations for the limits of these operators are given.

1. Introduction

Several formulations have been proposed to give a basis for the description of multichannel scattering processes. The first sufficiently general and correct of these approaches is due to EKSTEIN [1]. The essential point of his method is to define scattering states as limits of appropriately constructed time dependent Hilbert vectors. In contrast to other formulations channel Møller operators[1] are not needed and therefore it is not necessary to split the total Hamiltonian into a channel Hamiltonian and the interactions between the fragments. In particular the formalism developed in Ref. [1] makes it possible to treat scattering processes of identical particles without disregarding the Pauli principle during parts of the calculation. Thus it can be transfered to field theory which automatically assures the Pauli principle. Furthermore, with this method scattering states can possibly be defined, even if channel Møller operators do not exist (a discussion of these questions is given in the review article of BRENIG and HAAG [3]).

Refering to EKSTEIN's basic idea and generalizing them HAAG [4] has defined "in"-respectively "out"-states for the scattering of (in general composite) particles in the relativistic field theory. Furthermore he proved the existence of these asymptotic states. This proof was made rigorous by RUELLE [5] under the premises of the Gårding-Wightman axioms and additional spectral conditions. Especially, RUELLE was able to show the

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[1] See, e.g., Ref. [2].